US Army Corps of Engineers
Waterways Experiment Station

Zebra Mussel Research
Technical Notes

Section 1 — Environmental Testing | Technical Note ZMR-1-30

October 1995

Zebra Mussel Densities in St. Paul District, 1991-1994

Background In September 1991, an adult zebra mussel (*Dreissena polymorpha*) was discovered attached to a native mussel near La Crosse, WI. Another specimen was discovered at Lock and Dam 8 in January 1992 during an inspection of the dewatered lock. In 1992, the U.S. Army Engineer District, St. Paul, initiated a zebra mussel monitoring program at the locks and dams within its jurisdiction (from the head of navigation at Lock and Dam Upper St. Anthony Falls in Minneapolis, MN, to Lock and Dam 10 in Guttenberg, IA). The results of monitoring in 1992, 1993, and 1994 are presented in Yager (1992a), Yager and others (1993), and Yager and others (1994), respectively. As of January 1995, zebra mussels have been detected at all locks and dams in the St. Paul District. Estimated densities of zebra mussels have increased substantially since 1992, in some cases increasing 50-fold (Yager and others 1994).

Structural maintenance of the locks and dams in the St. Paul District portion of the upper Mississippi River (UMR) is usually conducted on a rotating basis, with one lock dewatered each year for maintenance and rehabilitation. Locks and Dams 8, 9, and 6, were dewatered in 1991, 1992, and 1993, respectively. In early December 1994, Lock and Dam 7, located at La Crescent, MN (Figure 1), was dewatered for major maintenance and repair. The dewatering provided an opportunity to collect information on the densities of zebra mussels on the lock floors and walls within the chamber.

Purpose The purpose of this technical note is to summarize the zebra mussel densities found in Lock and Dam 7 at La Crescent, MN, in 1994. In addition, zebra mussel densities for 1991-93 and projected densities for 1995-97 at St. Paul District locks and dams are discussed.

Additional information This technical note was prepared by Mr. Tim Yager, U.S. Army Engineer District, St. Paul, Environmental Resources Division. Contact Mr. Yager, (612) 290-5277, for additional information. Dr. Ed Theriot, U.S. Army Engineer Waterways Experiment Station, (601) 634-2678, is Manager of the Zebra Mussel Research Program.

Prepared and published by the Zebra Mussel Research Program, U.S. Army Engineer Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39180-6199.

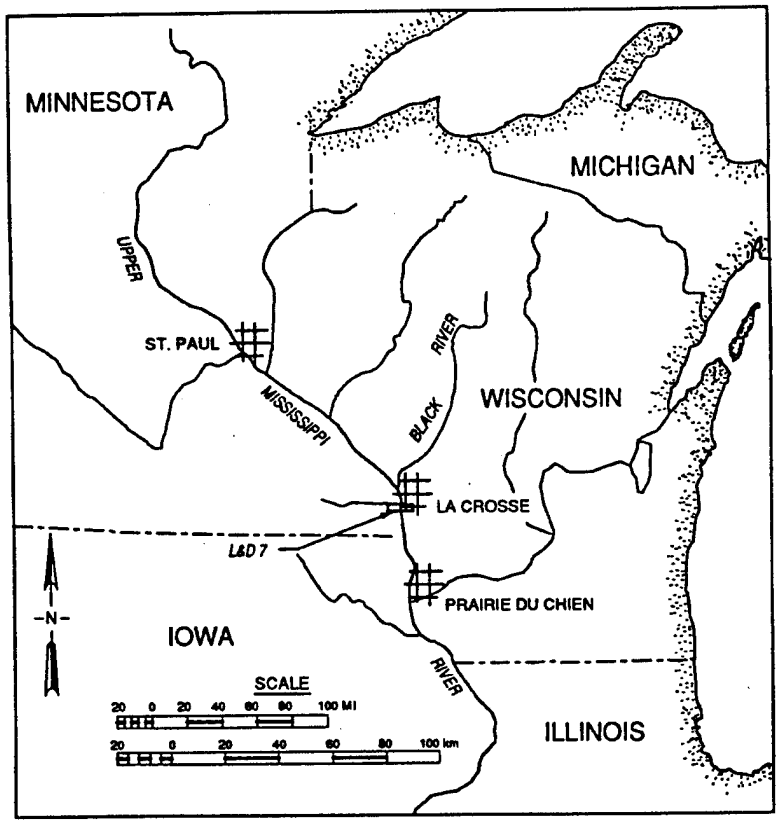

Figure 1. Area map of Lock and Dam 7 and UMR

Methods Zebra mussels were sampled from the floor and walls within the dewatered chamber of Lock and Dam 7. A 0.05-m^2 (6- by 6-in.) quadrat was haphazardly placed at various locations on the floor and walls of the chamber. Zebra mussels within the quadrat were removed from the concrete surfaces using a 7.6-cm-wide paint scraper. The mussels were retained in zipper-lock bags and later counted. Zebra mussel densities (number per square meter) were calculated, and the total number of zebra mussels at the lock was estimated. Also, the total number of zebra mussels likely to be in the lock in 1995-97 was estimated.

Results Zebra mussels were attached to the floor, walls, and other hard surfaces throughout the chamber of Lock and Dam 7. The mean zebra mussel density on the floor was 2,220 individuals/m^2 (Table 1). The mean zebra mussel density on the walls was 861 individuals/m^2 (Table 2).

Table 1. Zebra Mussel Sampling, Lock Floor of Lock and Dam 7

Replicate	1	2	3	4	5	6	7	Mean	Standard Deviation
Number	170	94	72	33	38	24	15	64	50.5
Number/ft^2	340	376	288	132	152	96	60	255	116.7
Number/m^2	3,660	4,047	3,100	1,421	1,636	1,033	646	2,220	1,256.5

Table 2. Zebra Mussel Sampling, Lock Walls of Lock and Dam 7								
Replicate	1	2	3	4	5	6	Mean	Standard Deviation
Number	16	18	22	21	23	20	20	2.38
Number/ft^2	64	72	88	84	92	80	80	9.52
Number/m^2	689	775	947	904	990	861	861	102.5

Discussion

The lock chamber is approximately 183 m long by 33.5 m wide by 9.14 m high. Under normal conditions, water levels in the chamber inundate approximately 6.7 m of the 9.14-m-high wall. However, zebra mussel attachment on the walls of the chamber appeared to be limited to the lower 2 m of the wall. Presumably, the scraping action of barges on the wall surfaces above this point prevents attachment. The floor of the chamber is continuously inundated. Not considering the internal tunnels and canals in the structure, during normal operations approximately 6,130 m^2 of surface area on the floor and 730 m^2 on the walls are underwater and available for zebra mussel attachment. Multiplying these surface area numbers by the calculated mean densities of zebra mussels on the floor and walls suggests that about 13.6 million and 630,000 zebra mussels could have existed on the floor and walls, respectively, prior to dewatering. Zebra mussels were attached to many other surfaces in the chamber, including the gates and internal drainage canals and tunnels. No quantitative data were collected on these; however, zebra mussel densities on these surfaces appeared to be similar to those observed on the walls, about 860 individuals/m^2.

Considering all surfaces available for mussel attachment, it can be estimated that 15 to 20 million zebra mussels existed in the lock chamber prior to dewatering. For comparative purposes, one zebra mussel was collected from the dewatered lock chamber at Lock and Dam 8 in January 1992 (Yager 1992b). In December 1992, an estimated 2,000 to 5,000 zebra mussels were in the chamber of Lock and Dam 9. In December 1993, an estimated 120,000 zebra mussels existed in the lock chamber at Lock and Dam 6 (Yager 1993).

Conclusion

Numbers of zebra mussels are increasing exponentially in lock chambers in the UMR. This rapid increase at four locks is illustrated graphically in Figure 2. The total number of zebra mussels in a chamber increased from near zero in 1991 to approximately 9,000 by 1992. By 1993 and 1994, total numbers of mussels was approximately 700,000 and 70 million, respectively. Comparisons among these locks are probably valid, although they have structural differences and are separated by several miles. If the trend depicted in Figure 2 continues, it is possible that a chamber could be infested with 2.0×10^{10} (20 billion) individuals by 1997. This could pose serious operational and maintenance problems at locks and dams in the St. Paul District.

References

Yager, T. 1992a. "Zebra mussel monitoring," U.S. Army Engineer District, St. Paul, St. Paul, MN.

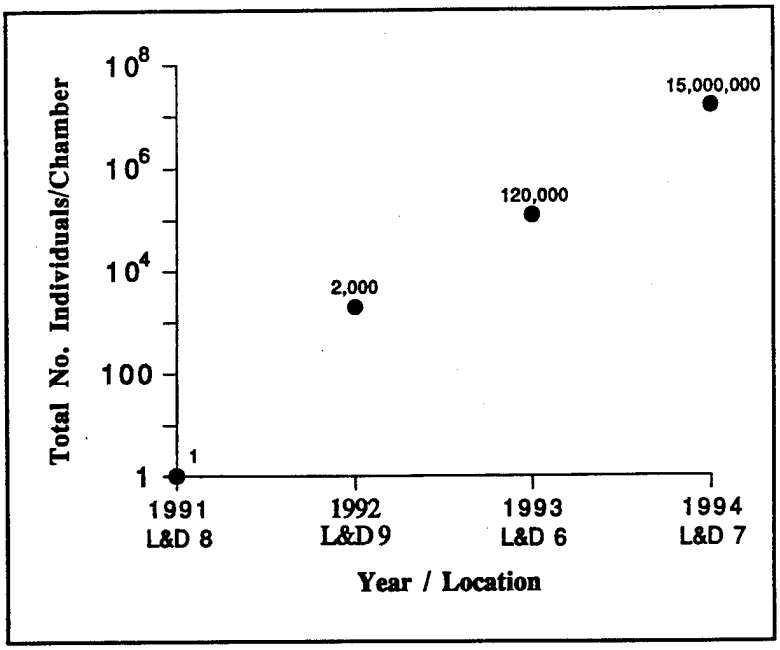

Figure 2. Total zebra mussels in St. Paul District lock chambers, 1991-94

Yager, T. 1992b. "Dewatered lock chamber, Lock and Dam 9, zebra mussel sampling," U.S. Army Engineer District, St. Paul, St. Paul, MN.

Yager, T. 1993. "Dewatered lock chamber, Lock and Dam 6, zebra mussel sampling," U.S. Army Engineer District, St. Paul, St. Paul, MN.

Yager, T., Sikkila, R., Hemstreet, T., Schroeder, K., Strand, E., Piel, R., Bauers, R., and Wolfe, B. 1993. "Zebra mussel monitoring, 1993," U.S. Army Engineer District, St. Paul, St. Paul, MN.

Yager, T., Sikkila, R., Hemstreet, T., Schroeder, K., Strand, E., Piel, R., Bauers, R., and Wolfe, B. 1994. "Zebra mussel monitoring, 1994," U.S. Army Engineer District, St. Paul, St. Paul, MN.